

LA-UR

79-1760

CONF-790724--1

TITLE: ELECTRONIC IDENTIFICATION AND REMOTE TEMPERATURE
MONITORING IN LIVESTOCK MANAGEMENT AND DISEASE CONTROL

AUTHOR(S): G. L. Seawright
D. M. Holm

SUBMITTED TO: XXist WORLD VETERINARY CONGRESS
July 1-7, 1979

MASTER

By acceptance of this article for publication, the publisher recognizes the Government's (license) rights in any copyright and the Government and its authorized representatives have unrestricted right to reproduce in whole or in part said article under any copyright secured by the publisher.

The Los Alamos Scientific Laboratory requests that the publisher identify this article as work performed under the auspices of the USERDA.

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED


los alamos
scientific laboratory
of the University of California
LOS ALAMOS, NEW MEXICO 87545

An Affirmative Action/Equal Opportunity Employer

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

ELECTRONIC IDENTIFICATION AND REMOTE
TEMPERATURE MONITORING IN LIVESTOCK MANAGEMENT
AND DISEASE CONTROL

Seawright, G. L. and Holm, D. M.
Los Alamos Scientific Laboratory,
Los Alamos, N.M., USA

INTRODUCTION

Since 1973 the Los Alamos Scientific Laboratory, of the U.S. Department of Energy, and the U.S. Department of Agriculture have cooperated in the development of an electronic identification and temperature monitoring system for widescale use in livestock. The system was developed to provide the livestock industry with an efficient method for animal management and disease detection and to provide regulatory agencies with a computer-oriented method for detecting diseased animals in commerce and tracing them back to their source. In this paper, we describe the system, summarize results of long-term experiments in cattle, and present plans for field trials.

SYSTEM DESCRIPTION

The electronic identification/temperature monitoring system consists of a passive (no batteries) transponder which is implanted under the skin of the animal and a remote interrogator/receiver (2). The transponder is energized by a beam of microwaves (915 MHz), sent out from the interrogator. The transponder circuitry modulates the transponder's reflection pattern in an encoded manner to give identification and temperature. The same antenna on the interrogator is used for powering the transponder and receiving the low frequency ($10\text{--}40 \text{ KHz}$) encoded back scatter signal. The hardware can be portable (hand-held) or fixed, depending on the application and degree of automation desired, and the data can be read out directly or stored in a computer-compatible format.

The temperature feature permits temperature measurements to be made at a distance from unrestrained animals. It can thus aid in the detection of disease and stress and perhaps ovulation and impending parturition. It may also find use in selective breeding programs by identifying favorable temperature markers in disease and stress-tolerant breeding stock (3).

The identification feature can be used for individual animal management and can also form the basis for an international livestock identification scheme. A 15-character identification code, suitable for an international scheme, has been proposed by the International Livestock Brand Conference and the National Electronic Identification Board (NLEIB). The latter group is made up of members representing all major livestock interests in the USA and is concerned that a system be marketed that will serve the "national needs." Each character can be one of 10 decimal digits or of six alphanumeric characters; with this code, all of the major livestock animals in the world could be individually identified. The actual assignment of the characters will be made after further study in which the cost and benefit of different formats have been considered. The technical feasibility of 15 characters (64 bits) has been demonstrated by a simulation with current units having three characters (16 bits) of identification. This requires the interrogator to get the same answer eight times before it indicates a reading.

The NLEIB has proposed a set of minimum functional specifications that a National Electronic Identification System should have to satisfy the major needs of the livestock industry. The proposed (1) specifications are as follows:

- 1) suitable for dairy, feedlot, salesbarns, performance testing, slaughterhouses, and remote locations (no AC power); 2) three-meter range; 3) conforms to safety standards; 4) ten-year lifetime of transponders (95% survival); 5) ten interrogations/day of transponders; 6) interrogation time less than 1/2 s; 7) erroneous readings less than 0.1%, 8) moving animals (24 km/h) read 99% of the time

9) implantable transponders must be sterile, small enough for calf implantation, biocompatible, and nonsurgically implantable; 10) concurrent identification and temperature readings; 11) 64-bit memory, 15 positions, with 10 numbers, six letters each position, 12) no duplicates, 13) readable in frozen animal; and 14) temperature readings should span 30-45°C with a resolution of $\pm 0.1^{\circ}\text{C}$ and accuracy of reading of $\pm 0.1^{\circ}\text{C}$.

This code will permit automated management of herd health, genetic and production records and can also be used to control the quantity and composition of food intake for individual animals. Where diseased animals are found at slaughter plants or at some point in their pathway through commerce, the code will permit disease control agencies to conduct computer-assisted traceback to the herd of origin.

ANIMAL EXPERIMENTS

Long-term experiments have been conducted in cattle to determine if implants migrate from the original site and to evaluate electronic performance over long periods of time.

Six temperature-only reading transponders were implanted in cattle at the National Veterinary Services Laboratories in December, 1975. One transponder was implanted in the pelvic cavity, between the sacrum and rectum, and five others were implanted subdermally behind the withers, 2-3 inches from the topline of the animal. Four of the subdermal implants were installed ventral to a horizontal incision and one was implanted caudal to a diagonal incision.

As shown in Table I, the pelvic implant (A1T1) and 3 of 5 subdermal implants (A4T2, A5T5, and A6T3) have functioned properly for at least 2-1/2 years. The subdermal implant made through a diagonal incision (A3T4) ejected in seven months but it was functioning properly at six months when it was last tested.

The remaining implant (A2T6) was working properly at six months, shortly before the animal died of unrelated causes.

These observations indicate that implanted transponders can provide reliable, maintenance-free temperature measurements over reasonably long periods of time.

FIELD TRIALS

Because laboratory experiments have confirmed the technical feasibility of electronic identification and temperature monitoring, plans are now being made for field trials in various user environments (1). Priority in the trial will be given to dairy and feedlot cattle. The field trials are scheduled to be started in 1979 with commercially built equipment at five sites and with equipment built by our laboratory at one site. In these trials a total of about 300 transponders will be tested.

The experiments will be designed to evaluate the instrumentation under field conditions and to determine if the system is cost effective to the user. Because fever and heat detection are important variables in determining cost effectiveness, it is important to find out how accurately subdermal temperatures reflect these events. To investigate this question, some animals will be instrumented with additional equipment that consists of battery-powered transmitters and a radio receiver to simultaneously monitor subdermal and deep body (ear canal) temperatures. Each of the transmitters continuously transmits temperature data at a unique frequency to a remote receiver, which can be placed up to 1 km away (4). The receiver monitors each transmitter in sequence until temperatures of all animals have been recorded and then it repeats the cycle. Battery-powered transmitters will be used because, unlike the I.D. system, continuous temperature measurements can be made up to 1 km from the animal, regardless of the animal's location relative to the receiving antenna. Because the identity

of the animal is provided by the transmitter frequency, only a few thousand animals can be identified in this manner. Also, the batteries need replacement about twice per year.

Commercial manufacturers of the instrumentation have been involved in the field trial to expedite the transfer of technology to private industry. We expect the field trial to provide information that will be valuable in guiding future development and application of the concept.

CONCLUSIONS

The system described here could form the basis for an international livestock identification system with disease detection capability. Veterinarians throughout the world should start to consider how widespread use of such a system could alter their approach to food animal disease control.

REFERENCES

1. Holm, D.M., Seawright, G.L., Araki, C.T., Nott, S.B., and Sanders, W.M., 1979. Experimental Plans for Electronic Identification Field Test. Proc. 63rd Annual Meeting of the Livestock Conservation Institute, May 8-10, 1979, Kansas City, MO., Monarch Printing Corporation, Chicago, Ill. In Press.
2. Koelle, A.R., Depp, S.W., and Freyman, R.W., 1975. Short-Range Radiotelemetry for Electronic Identification, Using Modulated RF Backscatter. Proc. IEEE 63:1260-1261.
3. Seawright, G.L., 1976. Remote Temperature Monitoring in Animal Health Management. U.S. Anim. Health Assoc. Proc. 80:214-230.
4. Seawright, G.L., Sanders, W.M., and Levings, R.L., 1978. Use of a Multiple-Animal Temperature-Telemetry System for Studying Infectious Diseases in Livestock. pp. 159-162 in H. - J. Klewe and H.P. Kimmich, Eds. Biotelemetry IV. Proceedings of the 4th International Symposium on Biotelemetry, Garmisch-Partenkirchen, Germany, May 28-June 2, 1978, Döring-Druck, Druckerei und Verlag, Braunschweig, Germany.

TABLE I. Transponder Implant Summary

Animal	Implant Site	Incisions	Disposition
A1T1	PC ^a	Diagonal	Working, 2.5 yrs.
A3T4	DPS ^b	Diagonal	Ejected, 7 mos.
A2T6	DPS	Horizontal	Working, 6 mos. ^c
A4T2	DPS	Horizontal	Working, 2.5 yrs.
A5T5	DPS	Horizontal	Working, 2.5 yrs.
A6T3	DPS	Horizontal	Working, 2.5 yrs.

^aPelvic cavity.

^bSubdermal dorsal postscapular region.

^cCalf died 6 months after implant from unrelated causes.